

Report to Congress on the Advanced Fuel Cycle Initiative (AFCI)

The Future Path for Advanced Spent Fuel Treatment and Transmutation Research



Briefing to Congress

**Office of Nuclear Energy, Science and Technology
U.S. Department of Energy**

January 2003



Near-term Issues Associated with Spent Nuclear Fuel

Today:

- 44,000 metric tonnes (MT) of spent nuclear fuel reside in commercial nuclear power plants in the U.S. and it contains 440 Mt of plutonium

By 2015:

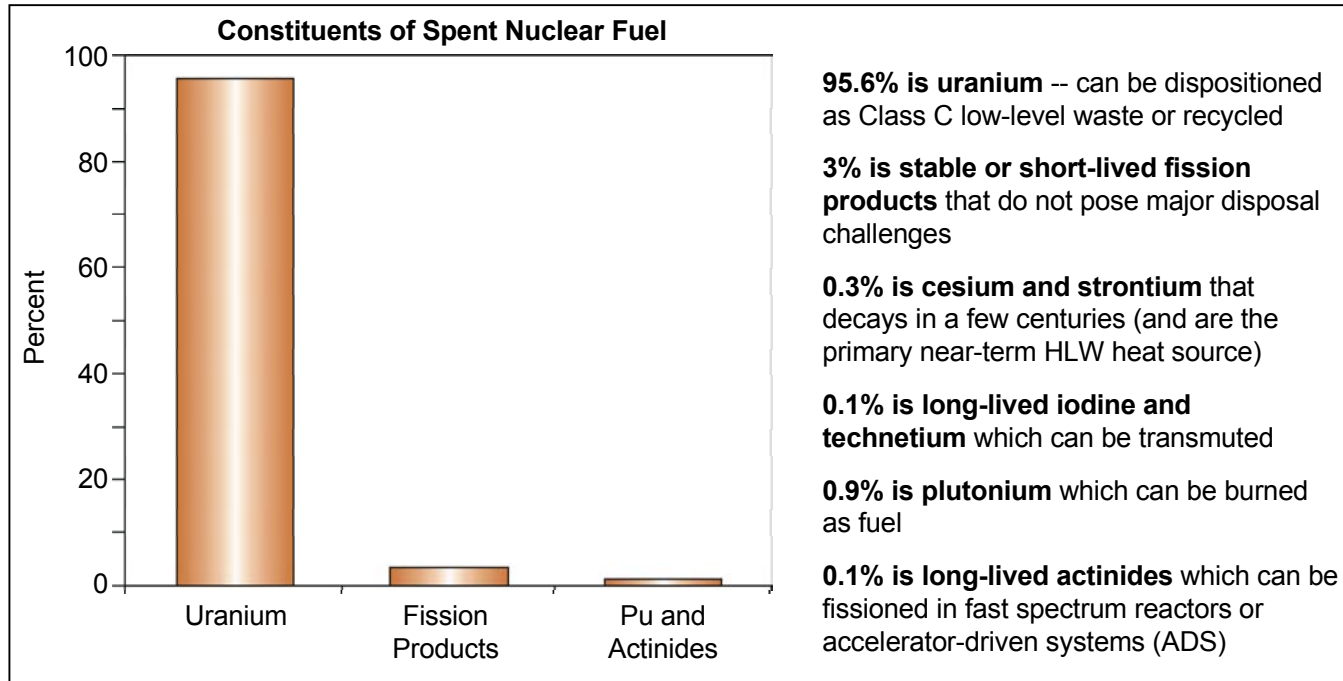
- 63,000 MT of spent nuclear fuel will have been generated
- \Rightarrow 630 MT of plutonium

By 2010:

- The Department is required to make a recommendation on a second geologic repository



What is Spent Nuclear Fuel Comprised Of?

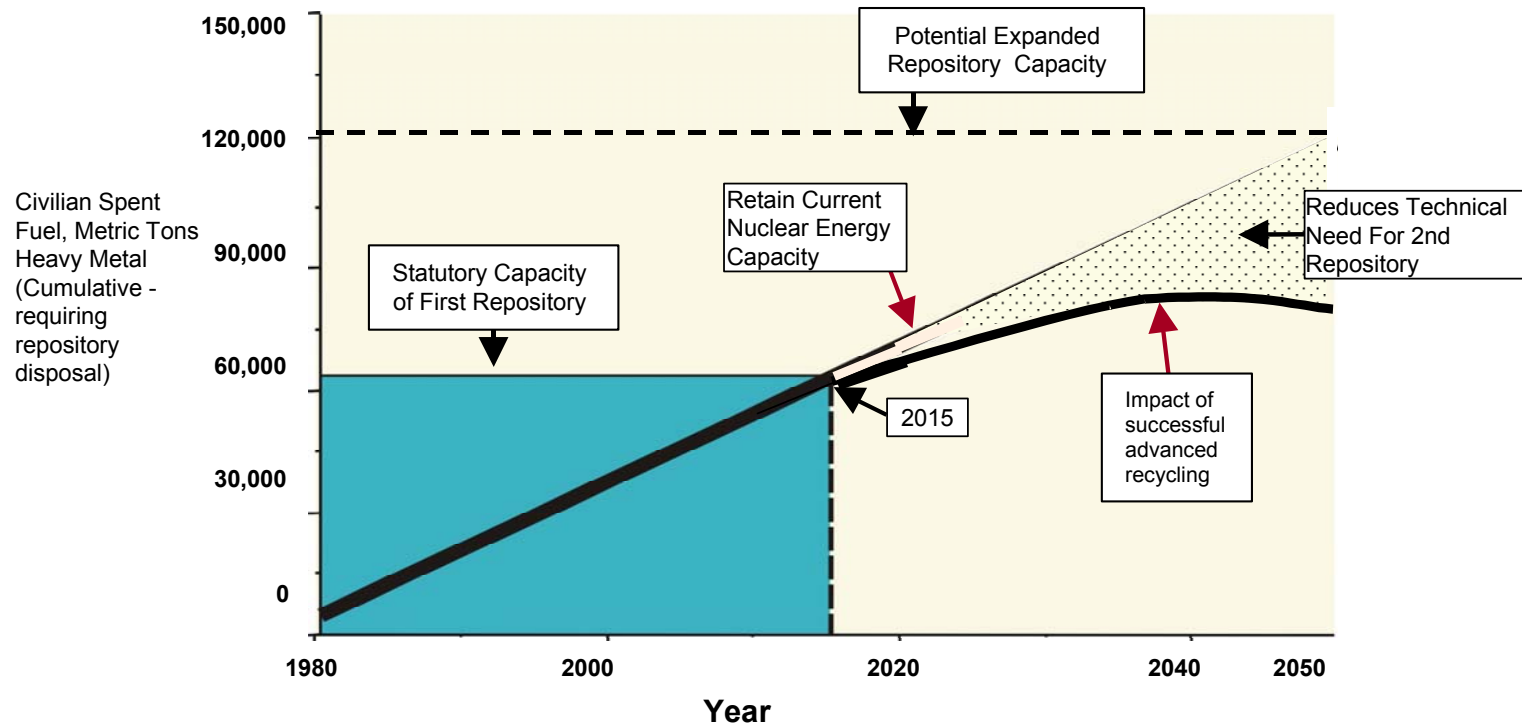


Spent Nuclear Fuel is Nearly 96 Percent Uranium

- ⌚ Simply removing this material would dramatically reduce the volume of high-level nuclear waste
- ⌚ AFCI has demonstrated in FY 02 removal of uranium from actual spent fuel at a purity of greater than 99.99 percent.



The Nuclear Waste Challenge



The AFCI technologies were commercialized in time to impact the first repository, they could provide the volume reduction required to avoid the technical need for a second such facility.



Advanced Fuel Cycle Initiative - The NEP Vision for a Long-Term Nuclear Energy Future

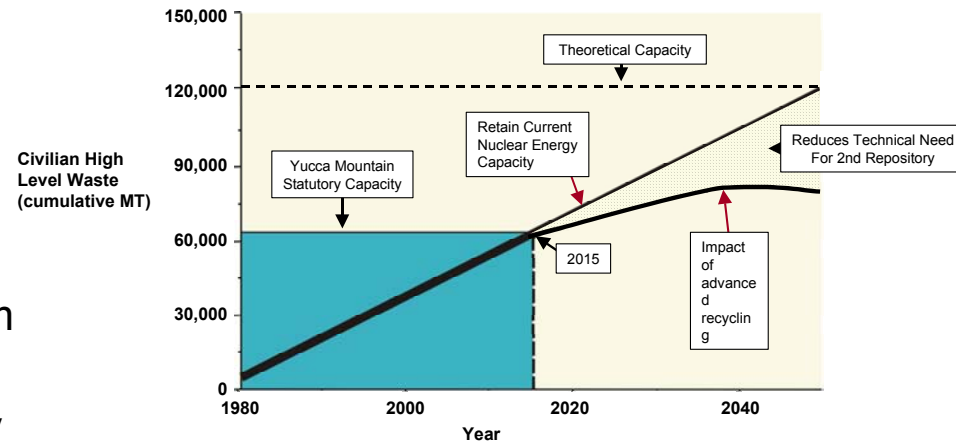
⌚ AFCI Series One - Near term (2015)

- Reducing high-level waste volumes
- Optimizing economics and performance of Yucca Mountain
- Reducing the technical need for a second repository
- Reducing long-term inventories of plutonium in spent fuel
- Enabling the proliferation-resistant recovery of the energy contained in spent fuel

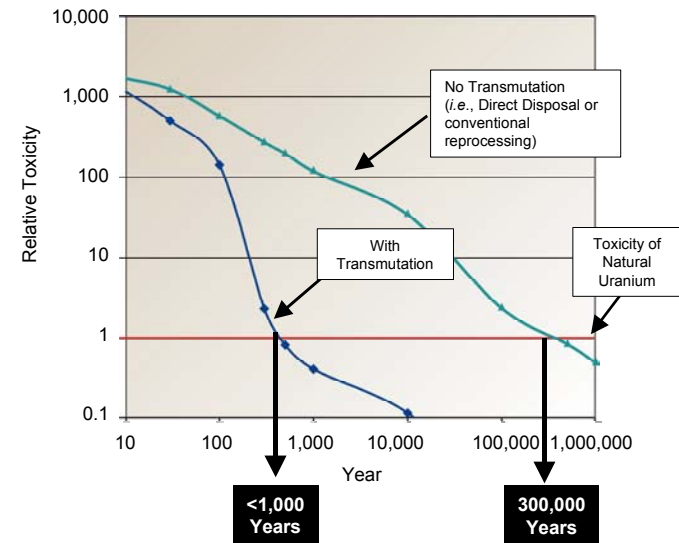
⌚ AFCI Series Two - Long term (2030)

- Reducing the toxicity of spent nuclear fuel
- Reducing the long-term heat generation of spent nuclear fuel
- Providing a sustainable fuel source for nuclear energy
- Supporting the future operation of Generation IV nuclear energy systems
- Supporting potential advanced R&D cooperation with Russia

Reduce High-Level Waste Volume

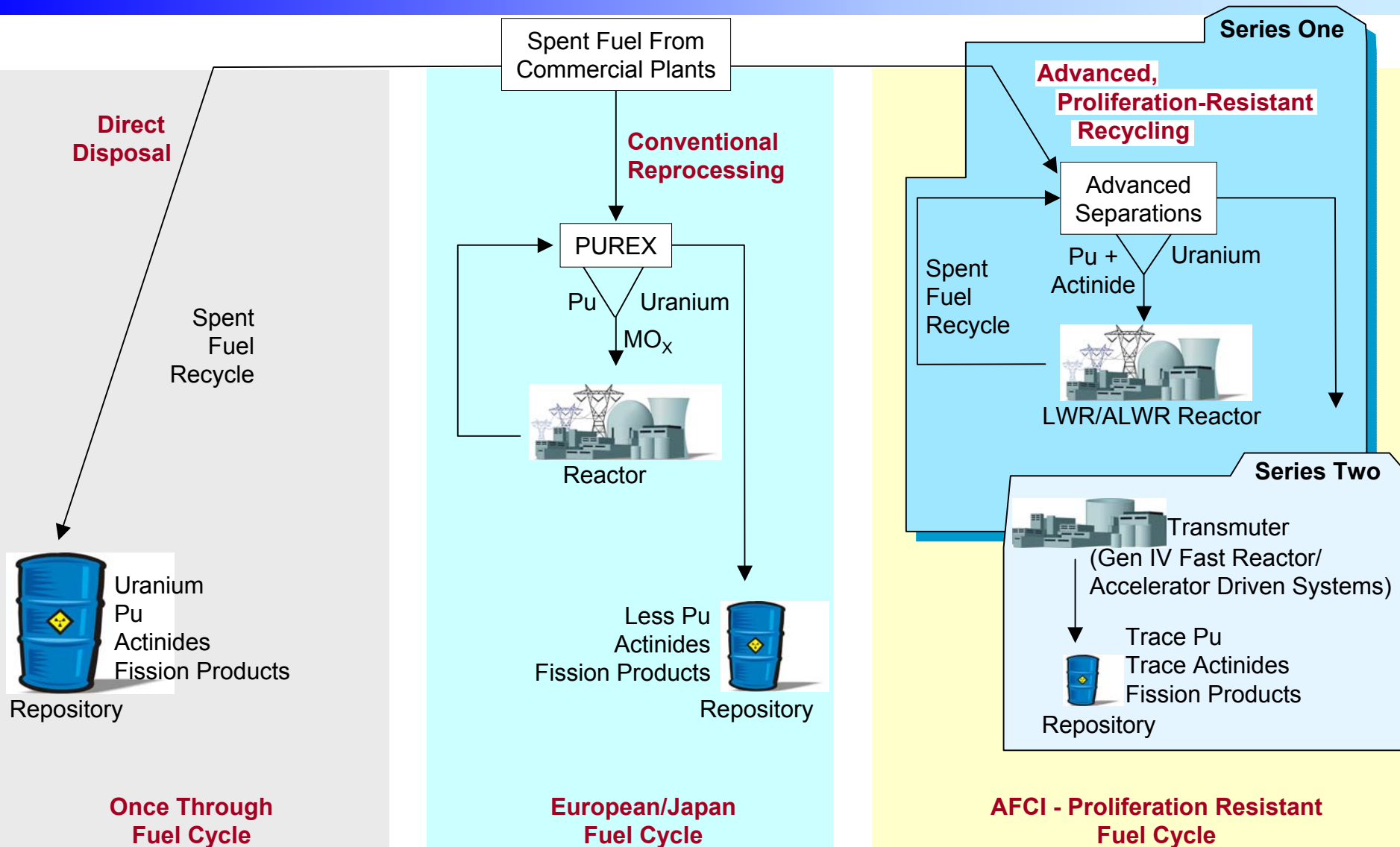


Reduce Toxicity of Nuclear Waste





Approaches to Spent Fuel Management





Recommendations of ANTT - Chaired by Nobel Laureate Burton Richter

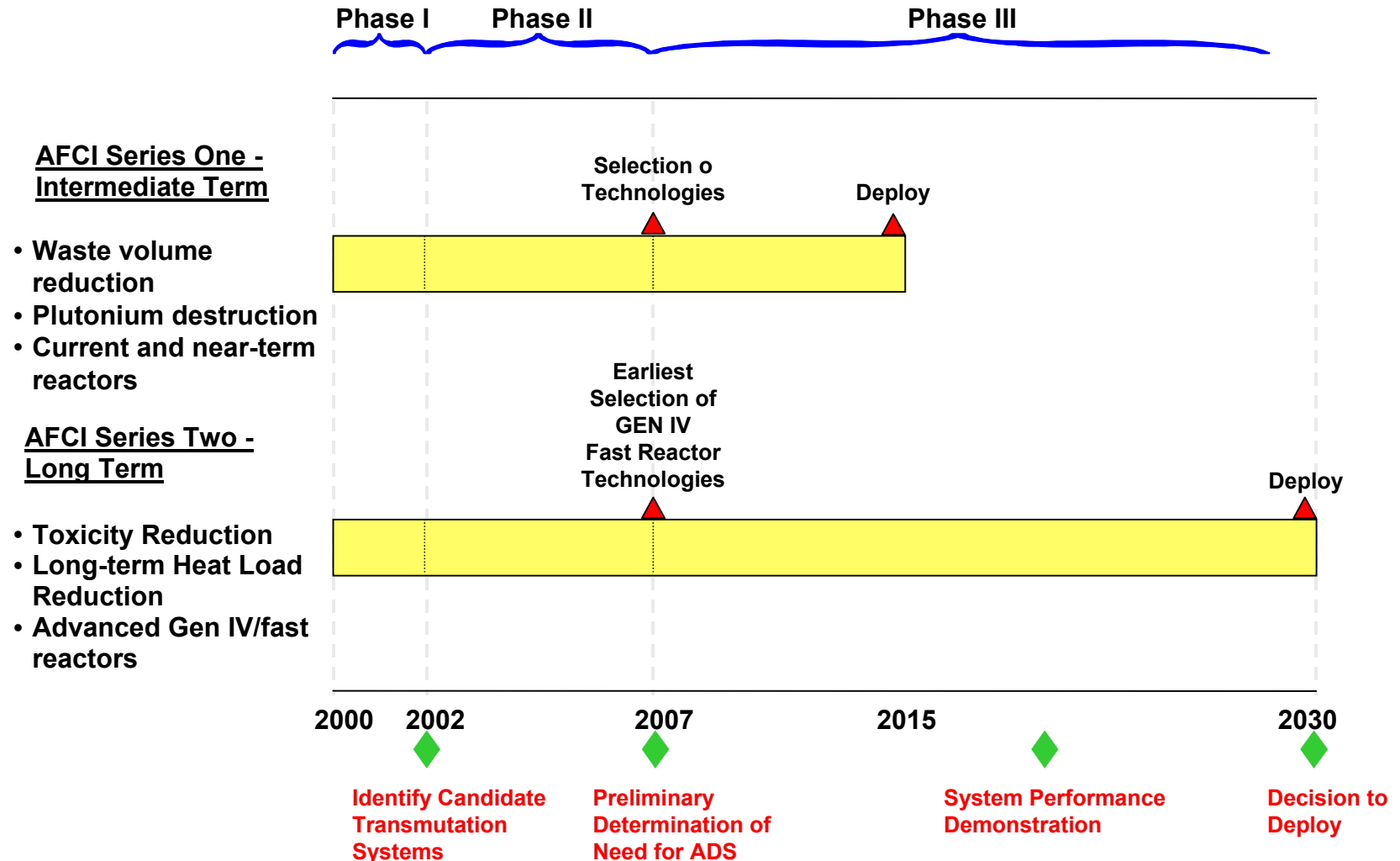
 **Systems Analysis Studies - analyzed reactor-based transmutation systems with/without accelerator systems**

 **Programmatic Phased Approach:**

- Phase I: “Basic Technology Evaluation” - complete in FY 2002
- Phase II: “Proof-of-Principle” - 5-6 year R&D program (\$100M/year) to identify technologies to provide decision makers with options for future path forward, including cost and schedule
- Phase III: “Proof-of-Performance” - scalable demonstration; 15-20 years



AFCI Programmatic Schedule





Phase III - Proof of Performance: (15-20 years)

Series One

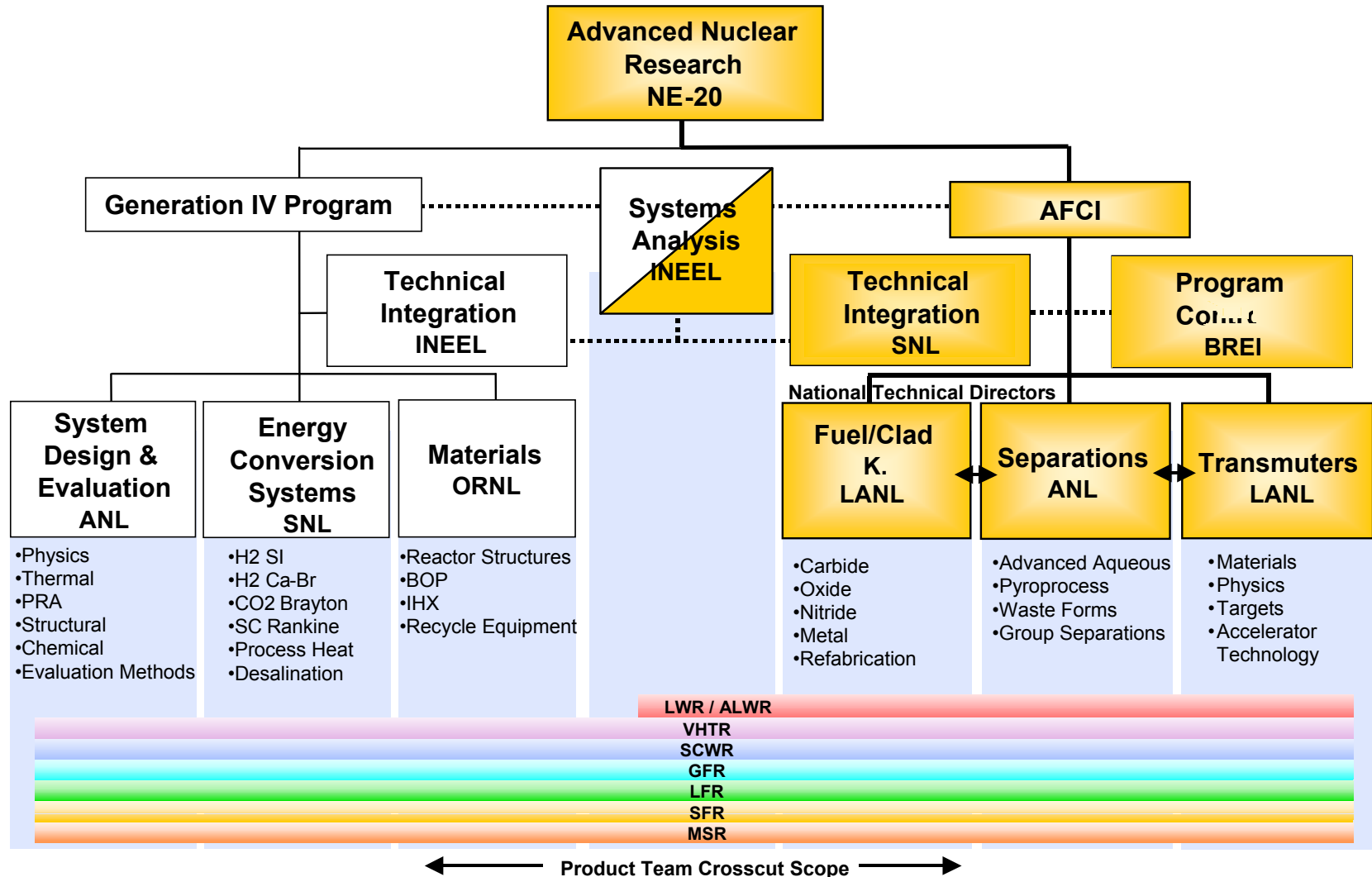
- Commercial Spent Fuel Treatment Facility
 - Final Design, Licensing and Operation
- LWR Lead-Test-Assembly Evaluation
- Commercial (LWR/ALWR) Fuel Fabrication Facility
 - Final Design, Licensing, and Operation
- International Collaboration Will Off-set Costs

Series Two

- Decision (2007) on Final Transmutation Technology -- (Fast Reactor, Accelerator Driven Systems, or both => Determines Testing Program
- Engineering Scale Demonstration of Advanced Pyroprocessing
- Demonstration Fuel Fabrication Facility
 - Design and Operation
- International Collaboration



AFCI/Gen IV Organization





AFCI Program Interfaces

External

- Nuclear Energy Research Advisory Committee (NERAC)
 - Advanced Nuclear Transformation Technology (ANTT) Sub-committee
- Office of Civilian Radioactive Waste Management
- Nuclear Regulatory Commission
- International Partners
 - CEA
 - Paul Scherrer Institute

Internal

- Generation IV
- Nuclear Power 2010
- Nuclear Energy Research Initiative (NERI) and International NERI



Resulting Outcome of Successful AFCI Program

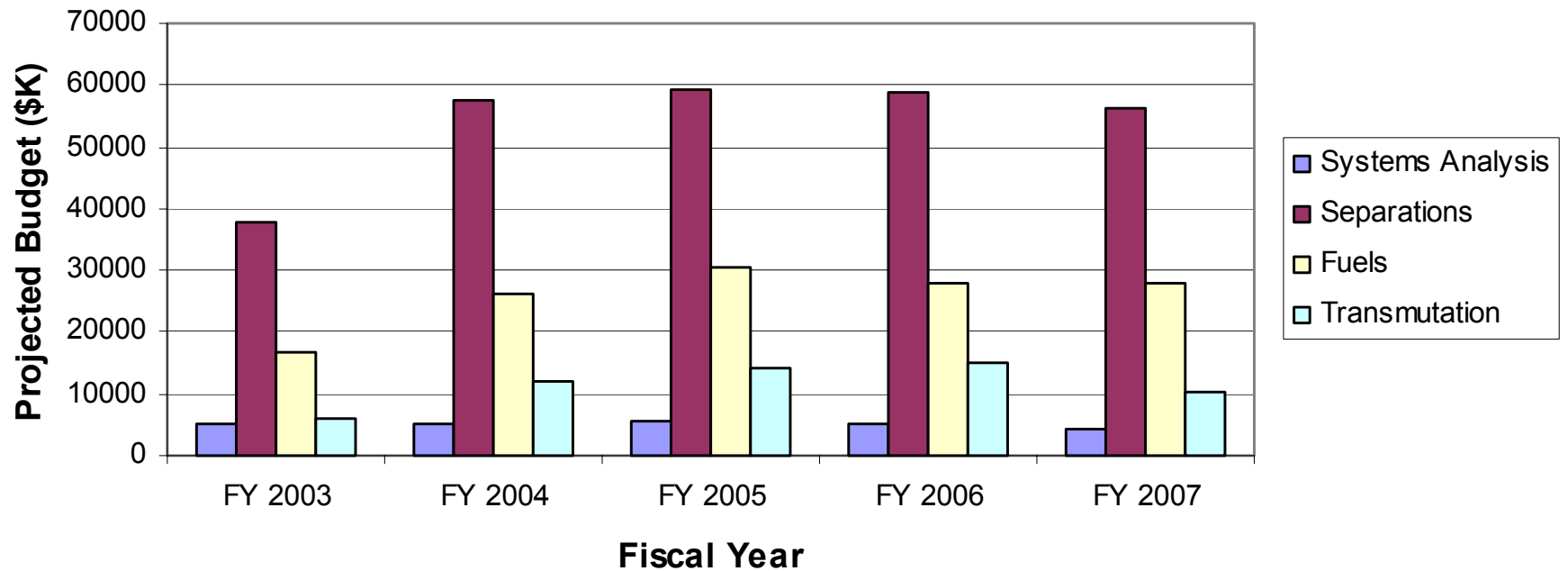
- ⌚ **Eliminate the technical need for a second geologic repository**
- ⌚ **Confirm advanced fuel cycle designs required for successful deployment of Generation IV nuclear energy systems**
- ⌚ **Potential cost savings of \$35-50 billion -- Repository**



Backup Information



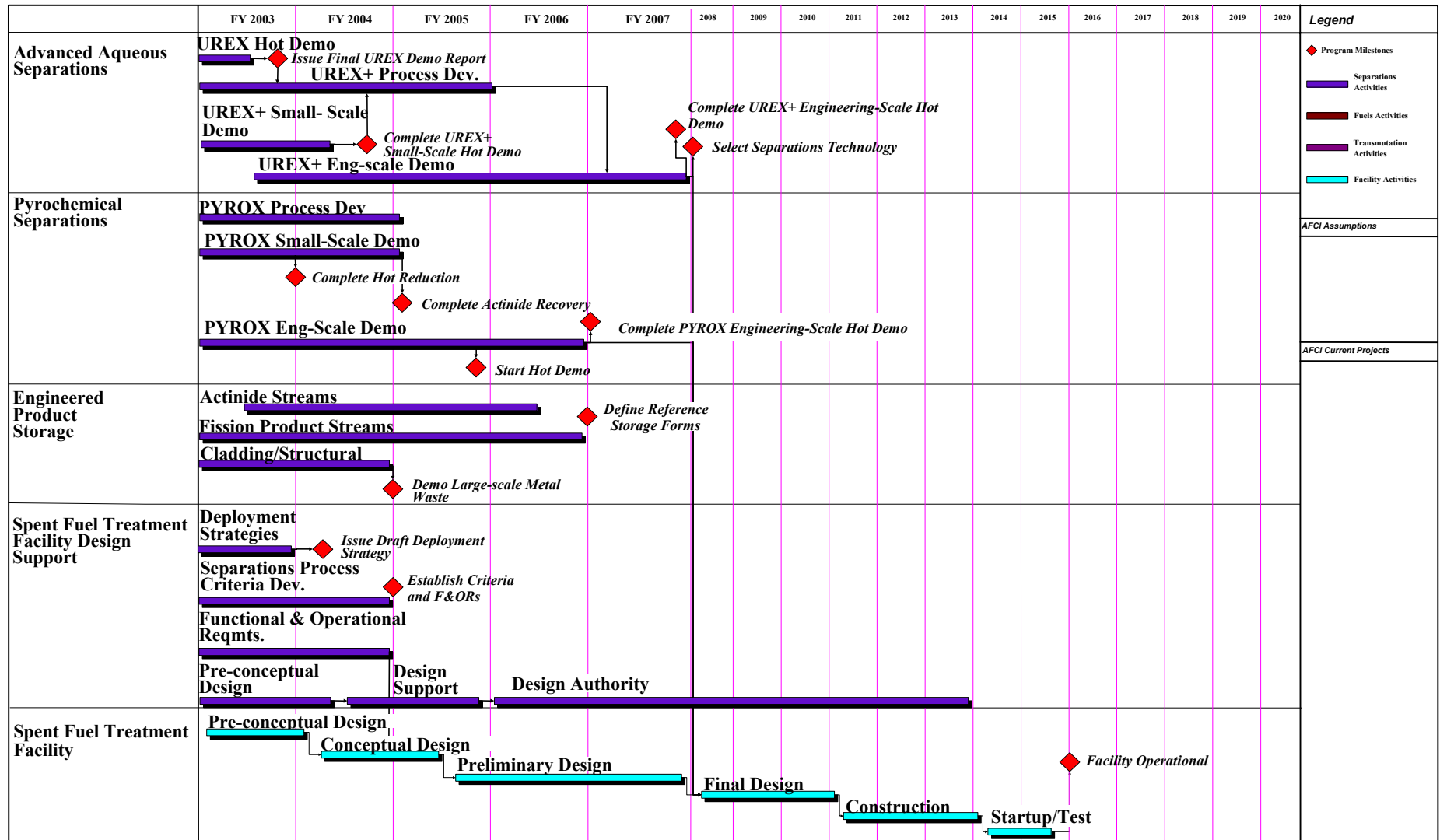
Five-Year Budget Profile for the AFCI Technical Areas





Advanced Fuel Cycle Initiative

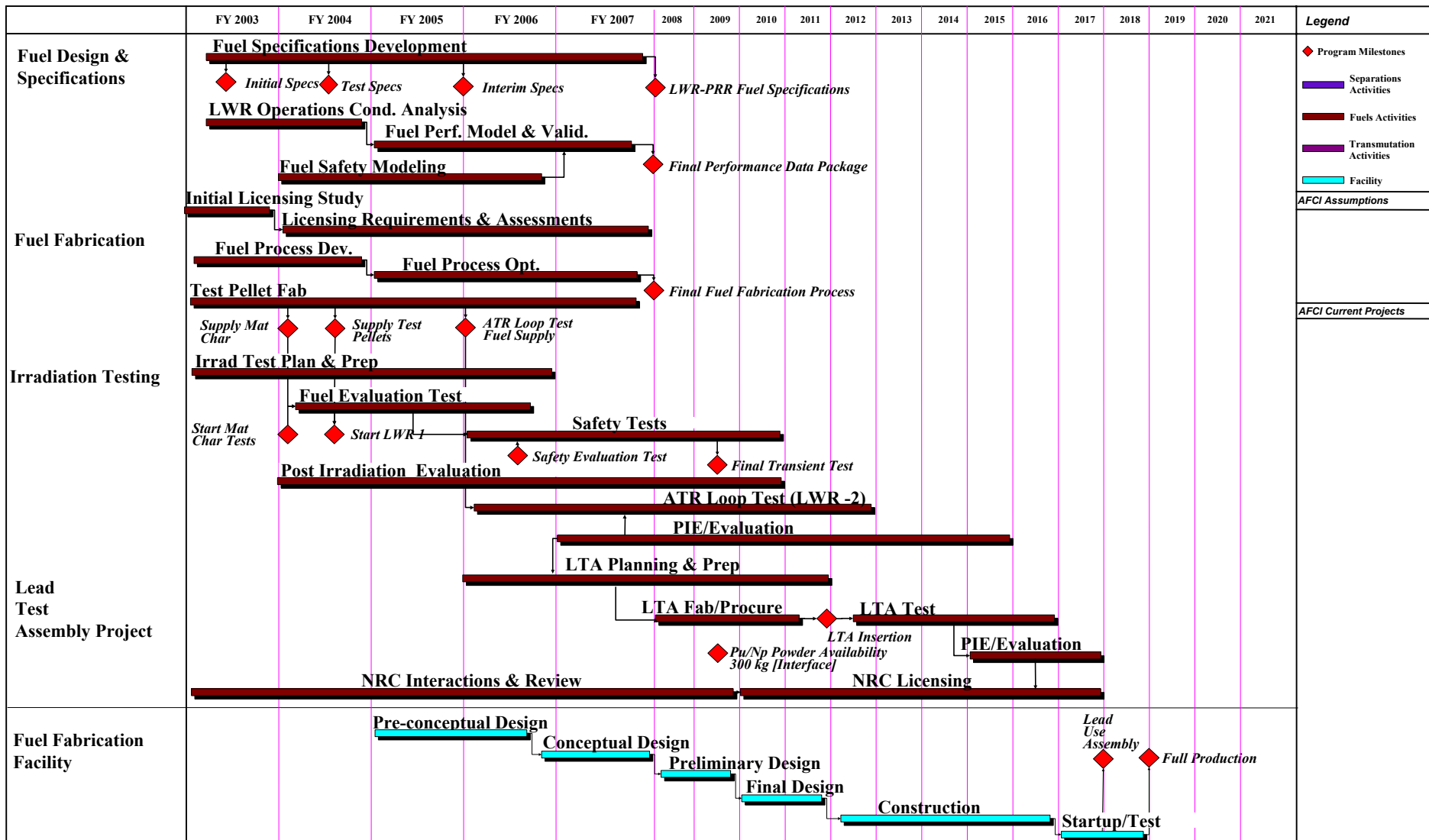
Separations Series One





Advanced Fuel Cycle Initiative

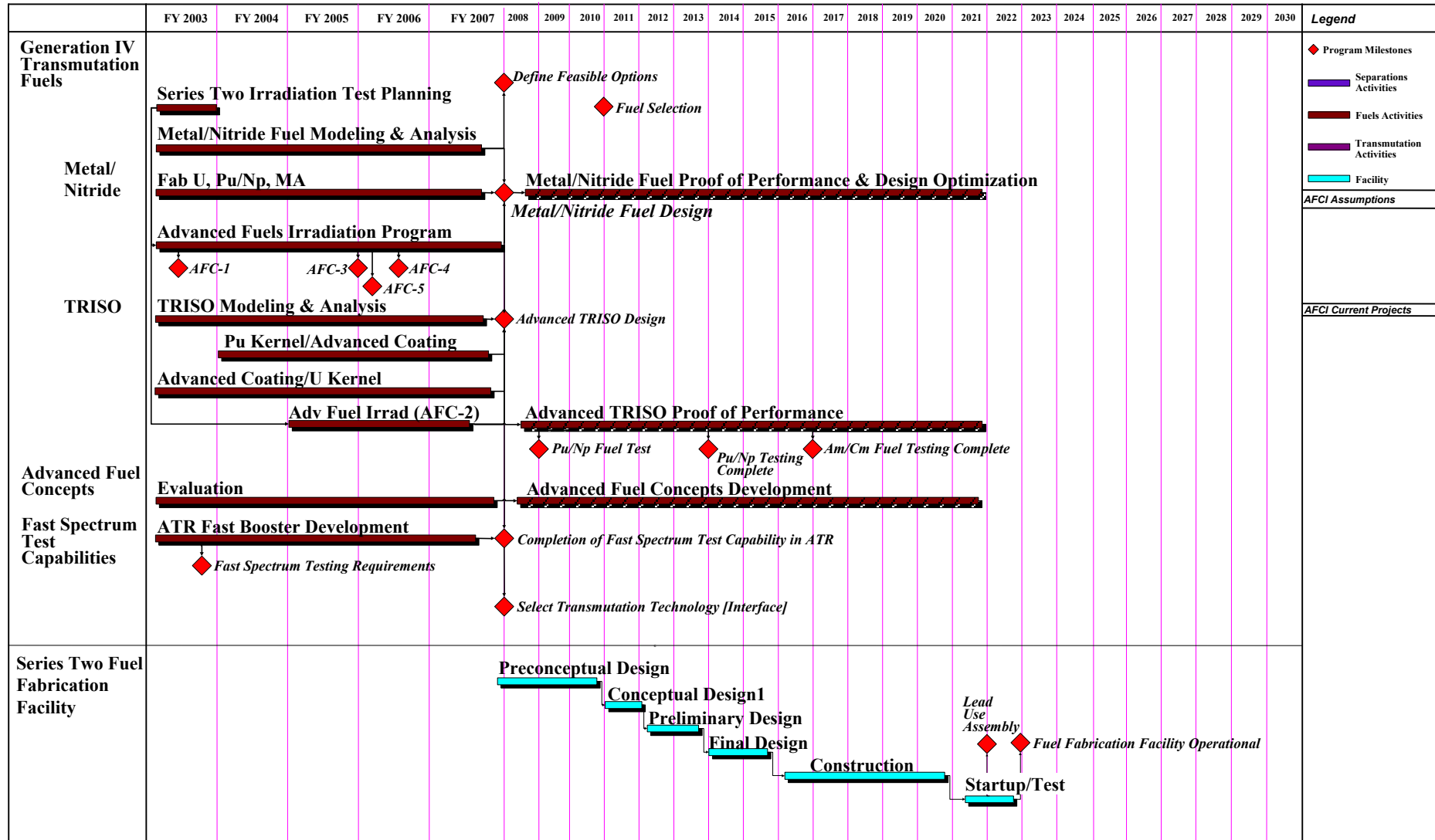
Fuels Series One





Advanced Fuel Cycle Initiative

Fuels Series Two





Phase II - Proof of Principle: *Two Parallel Paths (5-6 Years R&D) to Provide Information for Decision Makers*

AFCI Series One - Intermediate term (2015) - using current reactor technology management

- Reducing high-level waste volumes
- Optimizing economics and performance of the planned geologic repository
- Reducing the technical need for a second repository
- Reducing long-term inventories of plutonium in spent fuel
- Enabling the proliferation-resistant recovery of the energy contained in spent fuel

AFCI Series Two - Long term (2030) - using fast reactor technology

- Reducing the toxicity of spent nuclear fuel
- Reducing the long-term heat generation of spent nuclear fuel
- Providing a sustainable fuel source for nuclear energy
- Supporting the future operation of Generation IV nuclear energy systems